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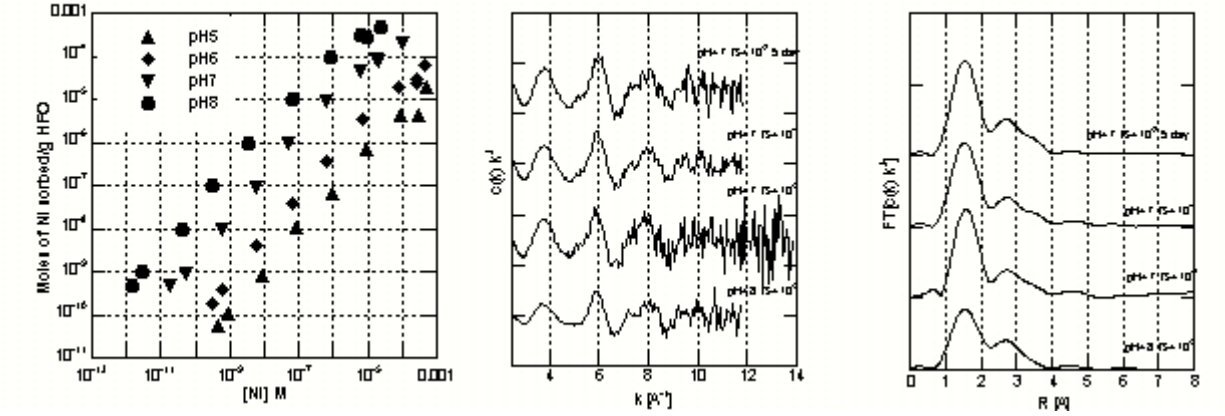
XAS Study of Heavy Metal Adsorption to Iron Oxides
Y. Xu and L. Axe (NJIT)
Beamline(s): X11A

Introduction: Metals speciation and distribution in contaminated systems are associated with oxide minerals in soils and sediments. Macroscopic studies alone do not provide sufficient information about the fundamental reaction mechanisms at the mineral/water interfaces, therefore in situ XAS studies are being conducted [1]. Understanding molecular level data on heavy metal adsorption to oxide minerals is important in modeling their mobility. XAS studies are complementary to macroscopic studies in developing mechanistic models for metal sorption to oxides.

Methods and Materials: XAS samples were prepared with either nickel or lead adsorption to 1 g/L iron oxide as a function of pH, ionic strength, and temperature. Systems were completely mixed before centrifugation for separating the adsorbent. EXAFS data have been collected in both transmission and fluorescence mode.

Results: The left figure is the Ni adsorption isotherm on 1 g/L HFO at different pH, ionic strength 2.8×10^{-2} and room temperature. Ni adsorption increases with increasing pH values because of the more negative surface charge on the HFO surface at higher pH. Although macroscopic studies assist in assessing thermodynamic parameters, XAS is needed to understand the adsorption mechanisms at molecular level. The middle figure is the EXAFS data of Ni-HFO adsorption samples collected at X11A with 13-element detector. The right figure is the Fourier transforms of the EXAFS data. After EXAFS fitting, local structural information such as coordination numbers and bond distances will help in determining the most appropriate model for sorption to hydrous metal oxides. Further analysis is still in process.

References:
[1] Brown, G. E. Jr., “Spectroscopic Studies of Chemisorption Reaction Mechanisms at Oxide/Water Interfaces” in “Mineral-Water Interface Geochemistry” (Eds. Hochella, M. F., White, A. F.), Mineralogical Society of America, 23, 337, 1990.



Left: The Ni adsorption isotherm on 1 g/L HFO at different pH, ionic strength 2.8×10^{-2} and room temperature. Middle: EXAFS data of Ni-HFO adsorption samples collected at X11A with 13-element detector. Right: Fourier transforms of the EXAFS data.